Governor's Task Force on Science, Technology, Engineering and Math Education (STEM)

Thursday June 19, 2014

Dyn Corporation, Manchester, NH

Task Force Members in Attendance:	Ross Gittell, Chairman; Brian Blake; Joyce Craig; Mary Kate Hartwell; Joseph Helble; Jeremy Hitchcock; Robert Hollowell; Dean Kamen; Todd Lamarque; Paul Leather; Palligarnai Vasudevan.
Unable to Attend:	Barbara Couch; Susan D'Agostino; Caroline Herold
Others present:	The Honorable Theodore L. Gatsas, Mayor, City of Manchester; Molly Connors, Policy Advisor to Governor Hassan; Donald E. Bossi, President, FIRST; Phil Browne, retired science teacher; Sarah K.B Grosvenor, Field Specialist, Youth and Family, Cooperative Extension, Hillsborough County, University of New Hampshire; Dr. Stephen Hale, STEM NH Coalition and University of New Hampshire; Sally Jean, Keene State University; Jeffrey F. Kessler, Liaison, New Hampshire Society for Technology in Education; Dr. Michele L. Munson, Educational Program Consultant, NH EPSCor-STEM NH, University of New Hampshire; Lynn Stanley, LICSW, Lead, New Hampshire Afterschool Network; Dr. Mark Wiley, University of New Hampshire; Zachary Fowler, Technology Educator, Ross A. Gurgio MS School.

I. Call to order

Chairman Gittell opened the meeting at 4:00 pm by welcoming members of the Task Force and the public who were present at the meeting. He asked all present to introduce themselves.

II. Approval of May 27, 2014 minutes

Robert Hollowell made a motion to accept the minutes. Mary Kate Hartwell seconded. The minutes were approved unanimously.

III. Reports from STEM Task Force A, B and C

Chairman Gittell asked the Task Force Teams A, B & C to report on their work. Each team report was followed by feedback from the entire Task Force. Team handouts are attached.

Team A: How do we get students excited?

1. Overview: Develop a K-12 NH STEM pathways model ranking developmentally appropriate opportunities to build excitement and understanding of STEM related subjects, with a focus on universal access through school-based, statewide programs such as STEM competitions, daily curriculum, STEM Career and Technical Education (CTE) programs and magnet high schools.

2. Major Ideas:

a. Anchor STEM exposure in school-based, statewide competitions to expose students at all grade levels to STEM related projects, as well as build school and cohort spirit around experience (similar to K-12 sports model)

b. Consider magnet high schools as a progression for those students who demonstrate an interest and skills for more advanced STEM study. A residential school was proposed similar to models in other states such as the Institute for Math and Science Academy in Illinois

c. Consider revising the Career and Technical Education programs at the regional centers to create STEM tracks (biotechnology, computer science, pre-engineering, etc.)

d. Build out the model for STEM pathways drawing from examples such as Vermont's "Flexible Pathway Act 77" which provides personal learning plans for all students in grades 7 and 9. Also draw from the work of the Advanced Manufacturing Education Council, New Hampshire

3**. Feedback from Task Force:**

Task Force suggested more work on magnet school concept to adapt it to New Hampshire (typically magnet schools are established in population centers larger than most in New Hampshire), and to consider charter schools, Career and Technical Education schools, summer camps and bridge programs as STEM education options to engage students. Additionally, Task Force urged more attention to specific recommendations for individualized learning plans and pathways planning for middle school and high school students.

<u>Team B: How do we empower educators?</u>

1. Overview: Resource and develop K-8 "laddered" STEM education that involves developmentally appropriate "steps" in the STEM fields with applied field-based and in-class projects and curriculum that engages K-8 faculty with students and with the support and engagement by industry and STEM faculty expertise at NH universities of colleges. Additionally establish professional development hubs for STEM educators and a central repository for STEM curricula, best practices and other teaching resources.

2**. Major Ideas:**

a. Make science part of everyday for every student in K-8 by making models and resources available to Districts

b. Provide teachers with science kits/resources (especially in K-6) to empower teachers not versed in science topics

c. Create STEM professional development hubs which could be co-located in existing regional facilities of the Department of Education's centers for professional development and technology.[1] Consider stipends and awards for STEM teaching, and creation of a STEM master teacher training program (see extensive list on attached Team B handout)

d. Provide professional development to K-12 teachers to teach STEM in a laddered way similar to social science pathway (which scaffolds study from local government to state and Federal government)

e. Reinstitute position in DoE for STEM coordinator to assist statewide K12 schools with STEM program development

3. Feedback from Task Force:

Task Force reiterated support for teaching sciences every day, especially in K-8. Since there is insufficient time in the school day to teach an extended STEM curriculum, urged Team B to develop models to demonstrate how this could be accomplished. Consensus in support of STEM coordinator to assist K-12 schools, and suggested that shared resources are a good first step but that educators need planned opportunities to talk with one another.

Team C: What STEM-related standards/requirements should be in place to prepare in K-12 for a technology-driven economy?

1. Overview

Reviewed existing K-12 math and science standards with a focus on updating for STEM studies and teacher preparation sufficient to meet requirements for 21st careers. Emphasized problem-based, hands-on teaching and learning, and proposed new approaches to assessing learning more closely linked to authentic (hands-on performance) assessments.

2. Major Ideas

a. Expand math standards to offer multiple pathways by including applied math courses such as statistics, data analysis, coding, all of which have practical applications in most careers today and provide problem-solving foundations for math, science and other STEM study

b. Recommend science standards for NH after a review of national models such as *Next Generation Science Standards* and standards of other states

c. Prepare recommendations for teacher preparation in STEM fields including revisions to teacher preparation curricula, summer institutes for educators in STEM and other continuing education opportunities

d. Further investigate assessment options appropriate to STEM learning

[1] Local Educational Support Network hosted by the NH Department of Education

2. Feedback from Task Force:
Task Force supported a competency-based approach to STEM education assessments, agreed that science standards need to be updated and concurred with proposed expansion to applied math standards. Also concurred that Team C should review and recommend standards for technology and engineering – in addition to math and science.

IV. Visit and remarks by the Hon. Maggie Hassan, Governor of New Hampshire
Governor Hassan urged the Task Force to think boldly and long-term, emphasizing that the Task Force recommendations would be significant in shaping the future of STEM education in the State.

V. Visit and remarks by the Hon. Theodore Gatsas, Mayor, City of Manchester
Mayor Gatsas asked the Task Force not to forget about the arts and to seek ways to include them in STEM education. He said that Manchester provided a model for how STEM-based competitions (sponsored by FIRST) could be integrated as credit-bearing course work in K-12 grades. In addition, he said that FIRST has brought business, industry and education together in providing financial support to pay teachers for extra time spent after school and weekends to prepare for the competitions. He also suggested the Task Force look at Manchester's academic standards which go beyond the Common Core requirements.

VI. Public Feedback:

Representatives from the public offered the following comments:

- Draw from existing STEM-best practices and programs in the State to leverage and scale recommendations;
- For teacher preparation, focus on inquiry –based and problem-based teaching; providing continuing education to retrain teachers in this teaching methodology;
- Use after school and summer programs to reach and teach students who may not receive STEM education during the school day.
- Work collaboratively with other organizations who are involved with STEM
- Reach out to Town selectmen, school boards and parents to involve them in the STEM conversation and to communicate the work of the Task Force.
- Seriously consider the Next Generation Science Standards and consider creating a position for a STEM coordinator or consultant
- Involve guidance counselors in STEM so they, in turn, can excite their students about potential STEM careers
- Consider role of web-based STEM learning

VII. Schedule of Meetings and other items:
1. Task Force website hosted by CCSNH is now active. Visit www.nhstem.org. Suggestions for improvement are welcome.
1. M. Parker will contact Task Force members to set up next meeting for the full Task Force and for individual Teams.
2. Dr. Brian Blake made a motion to adjourn the meeting. Meeting was adjourned at 6:00 pm

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ADDENDUUM FOR TEAM A, B, C DISCUSSIONS

Team A Status Update

How do we engage students?

1. Overview of Meeting:

Team A met on June 10th and we focused on developing "Big Ideas" in areas other than competitions and integrated STEM because we had discussed those in our previous meetings.

2. Magnet Schools:

The first topic discussed was the Magnet Schools – we defined this to be a high-end STEM based school in which students could earn a spot based on excellence in STEM. The analogy was made to the competition notion of a "world series" that inspires students in the lower grades ("Little Leagues") to excel in STEM. It could be that the Magnet school would be a group of schools (one for each regions of NH, or associated with Universities/Colleges). We believe it would need to be a residential school – allowing students to board at the school – that way we make it possible for any student to attend. In addition, to the inspirational aspect of the school it also provides NH businesses access to high-end students who may be more likely to stay in NH. We will be investigating examples of Magnet schools from other states to understand the logistics of such an endeavor.

Next steps: Martha is gathering some information on other magnet schools (size, focus, challenges, and successes) for Team A to review at our next meeting.

3. Structure of Career and Technical Education Programs

We discussed the current structure of CTE programs within the state and how they are attempting to use the model used for training in a trade to create tracks for STEM (biotechnology, computer science, etc.). There are only a handful of STEM careers under the CTE program and, therefore, each regional CTE program has only 1 or 2 options in the area of STEM. We believe the CTE structure could use a makeover – creating a separate emphasis in STEM. We discussed whether the CTE schools could become the STEM magnet schools, but we did not reach a firm conclusion. Do there need to be more direct partnerships with businesses? What programs should be offered? How should they be tied to direct college credit or degree programs?

Next steps: Gathering information on other CTE programs that are attempting to make the STEM transformation (for example the Hartford Center in White River Junction, VT)

4. STEM exposure

In the area of STEM exposure, SMEs and integrated curriculum we discussed models that might provide a mix of those services. For example, Project Learning Studio in Maryland http://nctaf.org/learning-studios/highlights/

5. Pathways

We had a brief discussion on pathways, followed by a more detailed email from Barbara Couch on complementary work that is going on as part of the AMEC (Advanced Manufacturing Education Council) In addition, she highlighted VT's "Flexible Pathway Act 77" which provides individual pathways and personal learning plans for all students in grades 7 and 9. The Act provides for dual enrollment opportunities paid for by the state, blended virtual learning, and work based learning credited internships. This link provides more information: http://education.vermont.gov/flexible-pathways,

Next steps: Gathering pathway planning in other states

At the end we had a discussion on whether we might be able to integrate all of our concepts into one "Big Idea" perhaps using the Magnet school concept as a unifying theme. But, more discussions are needed to see if that makes sense.

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ADDENDUUM FOR TEAM A, B, C DISCUSSIONS

Team B Status Update

How do we empower educators?

1. Overview from meeting June 2, 2014: Resource and develop K-8 "laddered" STEM education that involves developmentally appropriate "steps" in the STEM fields with applied field-based and in-class projects and curriculum that engages K-8 faculty with students and with the support and engagement by industry and STEM faculty expertise at NH universities of colleges. This is based on the premise that without teacher/faculty engagement student engagement is unlikely. Two key takeaways from June 2, 2014 meeting:

- Create repository to draw from –curricula for science teaching, best practices, resources
- Utilize the professional development hubs by organizing them to support STEM

2. Major Ideas Revised:

a. Make science part of everyday for every student in K-8

1. Determined that key challenge is the lack of time and the pressure to teach many different subjects. The challenge is to break through these subject "silos" and encourage an integrated, approach to teaching science (more effectively tapping into existing teaching periods for math and English language arts). By integrating science into both subjects, science could be taught every day, in little doses or in discrete themed projects such as the study of water, "wild weather"/ meteorology, agriculture/feeding a hungry planet, energy conservation, etc.

2. However this is the big perceptual challenge for many teachers as they tend to see each subject as separate and specialized, so getting the "integration" of STEM for every day, every child will need to be a focused and reinforced continually

3. Examples of integration sequence might be as follows: K-5 would study subjects which allowed integration of math, science and language (such as how weather happens, or how metamorphosis in butterflies occurs). Use pre-assessments of prior knowledge, lesson plans for content development and then experiential, hands on learning through projects and competitions

4. Since many schools tend to go into their own subject silos as they move into higher grades. At the 7^{th} and 8^{th} grades create STEM classes (or even for earlier grades 5-6, depending on the school organization)

5. To avoid concerns of curriculum "mandates"
   Models not mandates
   Resources rather than requirements

6. Ask the Governor to become the champion for STEM education, in order to help educate students, parents and other stakeholders as to the importance of STEM careers

b. Provide teachers with science kits/resources (especially in K-6) to empower teachers

1. Focus on the need to enhance teacher STEM preparation and training, particularly in K-6 where teachers are least likely to be trained to teach math and science. Provide support through stipends for continuing education in summer institutes and through professional training centers (described below)

2. Develop science kits/resources based on real world problems and take actions to make this happen as follows:

    - Establish a cloud-based repository for K-8 resources so that resources are accessible statewide (see item "c" below for companion piece). High School should be addressed separately since most schools have science specialists in different disciplines

    - Collect and store examples of science curriculum kits for K-8 from schools throughout NH schools, as there are probably a number of wonderful examples that are not being shared due to time and resources

    - Expand to collect science kits and resources from throughout the US and internationally (can also link to other sites where materials are available)

    - Build a resource file for experts/speakers to accompany each learning module (speakers from industry, universities, research centers) –and enable teachers to put in their school district or zip code for speakers in their area, if they wish

    - Integrate CTE subjects in K-8 STEM education and align CTEs with STEM goals and activities in high school

    - Add the capability for teachers to suggest new resources they would like to develop (encouraging a form of "wisdom of the crowds" to create and develop new tools for teaching)

c. Create New Hampshire STEM Education and Resources Training Center

1. Could be co-located in existing regional facilities of the DoE centers for professional development and technology, as well as in community colleges and Career and Technical Education Centers – combining both a virtual and physical presence)[2]

   Consider stipends and awards for STEM teaching - see extensive list on attached Team B handout from May 27 meeting)

2. Discussed the need to tap into existing hubs for STEM related professional development, and the need for at least one professional STEM coordinator to organize development and communication among various districts, science-based organizations, and professional trainings. Suggested reinstatement of a science/STEM coordinator through DoE

[2] Local Educational Support Network hosted by the NH Department of Education

3. Although discussed that hubs, which are locally funded, are always looking for ways to be useful to their local community, Team B might provide the "thought starters" for hub coordinators so that they might build community support

4. Create a "best practices" center for teaching science on the website, and enable teachers to add their ideas and experiences so that teachers are able to learn from each other

5. Hold monthly professional development webinars throughout the state and invite guest speakers from industry, universities and research centers

6. Provide professional development to K-12 teachers so that they might be able to teach STEM in a laddered way similar to social science pathway (which scaffolds study from local government to state and Federal government)

7. Create STEM master teachers/mentors/champions in NH K-12 schools

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ADDENDUUM FOR TEAM A, B, C DISCUSSIONS

Team C Status Update

What STEM-related standards/requirements should be in place to prepare in K-12 for a technology-driven economy?

1. Overview from meeting June 13, 2014:

Revisited math requirements briefly, focused on science K-12 requirements with questions of how to keep up with the speed of change in science and technology. Major focus on impact of assessments and evaluations as drivers of what is taught, and how learning is evaluated in both science and math. Determined the need for more "performance-based" assessments where student must apply learning to real-world problem by performing activities such as lab experiments or capstone projects. Issue of teacher preparation revisited.

2. Major Ideas revisited

a. **ReconsiderK-12 science requirements in NH**

Discussion:

World of science and technology are changing so quickly that State requirements and standards must be able to keep pace with change yet provide clear "bright line" for skills that students need to know. What science standards might meet this need? Also, what should be demonstrated mastery of standards (see evaluations and assessments discussion to follow)

Next Steps:

In addition to further review of national models such as the Next Generation Science Standards, Team C decided to investigate additional models (in other states and under development) in order to have a point of comparison. Of particular importance is how to keep standards constantly refreshed to keep pace with change which should be incorporated into final recommendations. Martha to collect Massachusetts and other standards (as requested by team) for next meeting.

b. **Reconsider math requirements**:

Discussion:

Discussion focused on demonstration of competencies, rather than on requirements or standards per se. Concurred that that statistics, data analysis and coding should be added and the role of Calculus I in math sequences before college. Team concurred that students are pushed to learn so

broadly that they often lack the depth of understanding to allow them to apply their learning to real world problems.

Also discussed that math and science assessments/evaluations give preference to forced choices (multiple choice), fill in the blank, etc., rather than assessments in which students apply their learning in real world performance-based situations.[3]

Next Steps: Discuss current math standards with Math Teachers Association to learn their ideas for change, and also consult other appropriate associations and organizations. Martha to contact Chicago district and other schools as suggested by committee to obtain copies of their standards and requirements for math.

c. Reconsider current teacher preparation for teaching of science and STEM

Discussion:

Revisited the problem of too few qualified teachers for science and math for those schools who do not require K-8 teachers to be certified in science and/or math. May Kate suggested two options (1) set up summer institutes for teachers to gain continuing education credits and offer stipends (often teachers don't have time during school year for extensive professional development); (2) tackle the problem by changing requirements and standards for teacher preparation in math, science and add STEM as a new requirement for study and certification.

Next Steps:

Review current teacher preparation requirements and standards for NH; talk with appropriate associations and organizations (especially teacher preparation programs in NH).

d. **Are evaluations and assessments too tightly coupled to teaching and learning?**

NH science, math standards and requirements provide the guidance for teaching but assessment and evaluations may be exerting too much influence on how standards and requirements are applied.

Discussion:

Jeremy suggested that it seemed that teaching/learning and assessments might be too tightly coupled. He suggested the team think about recommending that educators assess less frequently but in more depth. Team discussed capstone projects as a way to accomplish this goal enabling

[3] A form of assessment in which students are asked to perform real-world tasks that demonstrate meaningful application of essential knowledge and skills -- Jon Mueller
"...Engaging and worthy problems or questions of importance, in which students must use knowledge to fashion performances effectively and creatively. The tasks are either replicas of or analogous to the kinds of problems faced by adult citizens and consumers or professionals in the field." -- Grant Wiggins -- (**Wiggins, 1993, p. 229**).

"Performance assessments call upon the examinee to demonstrate specific skills and competencies, that is, to apply the skills and knowledge they have mastered." -- Richard J. Stiggins -- (**Stiggins, 1987, p. 34**).

multiple disciplines to be assessed in the application to a problem/project for an extended period of time.

Team recommended problem and performance-based assessment[4] so student can apply their knowledge to real world situations.

If STEM is taught but assessments remain isolated into subjects of math, science, etc., then educator will be influenced to teach that way. They discussed whether the State assessments could include capstone projects for a summative assessment of STEM learning.

Paul asked "what would you say is a true mark of mastery?" Vasu said that the mark of mastery is when a student can make a claim in science or math, support it with facts and or know where to find information to document it. For example, students should be able to formulate a problem based on the description, and use their knowledge of math of solve it. The same is true for science. Paul noted that although the new Smarter Balanced assessments to be implemented in NH in 2015include word problems – getting away from forced choices such as multiple choice – the assessments do not provide performance-based testing (which Paul referred to as "evidence-based assessments").

Next Steps: TBD

e. Don't neglect support skills such as keyboard skills

Discussion:
Team discussed that assessments, college studies and careers all require keyboard skills, yet not being taught in school in NH on a consistent basis. Some students are handicapped by lack of this training.

NOT ADDRESSED: How to encourage science being taught every day? Can standards and requirements be used to increase the time on science each day? Standards and requirements to encourage an integrated STEM curriculum?

[4] Paul noted that performance-based assessments are also known as evidence-based assessments. Also known as authentic assessments.